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ABSTRACT

This report describes the need for a state-level inservice education program for secondary mathematics public school teachers in North Carolina, in order to enable them to effectively implement computer use in classrooms. A decision model for policy analysis was used to determine optimal strategy for the program. Following a review of the literature on computer training for teachers, a list of program goals is introduced, alternative strategies are presented, chosen criteria are addressed and a decision matrix is graphically represented. Since present budget problems in North Carolina must be a primary consideration in choosing a strategy, the analysis suggests entering into partnership organizations such as the Mathematics and Science Education Network or the Semiconductor Research Corporation. This approach appears to be the best choice for meeting the goals and objectives of an inservice training program, since this strategy limits the need for state funds while ensuring high quality training from agencies created and staffed to promote this kind of program. Issues of program evaluation, unintended outcomes and overall impact complete the report. (LL)

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TRAINING NORTH CAROLINA'S SECONDARY MATHEMATICS TEACHERS FOR THE IMPLEMENTATION OF COMPUTERS IN THEIR CLASSROOMS

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Abstract

This paper focuses on the need for a state-level inservice education program for secondary mathematics public school teachers in North Carolina in order to facilitate the effective implementation of computers in classrooms. A model for policy analysis is used to determine the optimal strategy for the program. Based on this analysis, a partnership organization, such as the Mathematics and Science Education Network or the Semiconductor Research Corporation, appears to be the best choice for meeting the goals and objectives of the inservice training. Issues of program evaluation, unintended outcomes and overall impact are addressed.

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STATEMENT OF THE PROBLEM

Personal computer technology has been in existence for nearly fifteen years, and for most of that time, computers have been present in classrooms. Vast sums of money and effort have been expended to place computers in secondary classrooms in sufficient quantities to become a viable option for student learning. The National Council of Teachers of Mathematics (1991) has identified the use of computers as a necessary teaching tool for enhancing mathematical discourse in schools. Yet, computers remain misunderstood and underutilized by educators, largely due to a lack of training. It has become apparent that "...investments in technology cannot be fully effective unless teachers receive training and support" (Office of Technology Assessment, 1988, p.14). Tom Rich, director of programs and services for the Prince Edward Island Department of Education, expands on this idea (Rich, 1991):

> Current experience has shown that although expertise in [integrating computers into the teaching/learning process] can be gained through pre-service training, many of the skills will only be developed after practice in the classroom. Emphasis will have to be placed on in-service and professional development programs that relate specifically to the use of technology in the teacher's work. (p. 150)

To date, the problem of teacher computer literacy and the integration of computers in classrooms primarily has been addressed at the national level (e.g., Office of Technology

Assessment, 1988). This paper focuses on the need for inservice education of the approximately 2,350 secondary mathematics public school teachers of North Carolina (personal conversation with the State Department of Public Instruction, December 1991) to enable them to effectively implement computers in their classrooms.

This paper will employ Gallagher's (1981) decision model for policy analysis to determine the optimal implementation strategy for this proposed inservice training program. Once the program needs have been identified, the model requires making statements of program goals and objectives, listing alternative strategies, determining criteria for the choice of a strategy, and providing a means of evaluating the effectiveness of the chosen strategy. The remainder of the paper will address each of these considerations.

GOALS AND OBJECTIVES

This section begins by reviewing the literature on computer training for teachers, in order to derive the goals (indicated in bold print) for the proposed policy. A listing of the goals and objectives for the policy follows the review.

In a recent newsletter, the president of the Society for Applied Learning Technology (Fall 1991) provided a glimpse of what is needed for technology to be fully employed in classrooms:

> The directors of the Society decided,...,that it was important to encourage those who teach in public and independent schools to understand the capabilities and use of technology based learning systems. In so doing, it is necessary to take into account the current level of teacher knowledge and the methods whereby they can acquire competence in this technology which is new to them; and to identify how they can integrate it into

their classrooms. (p. 1)

The National Education Association (1983) has reported the results of a computer training/usage survey of 1,028 elementary and secondary teachers across the United States. When asked how well informed they were concerning various computer-related topics, 78.4% of the teachers responded that they were most uninformed about computer program selection/ evaluation. When asked what computer-related subject most interested them, the largest proportion of teachers, 59.1%, reported being interested in the subject of computer instructional applications. Overall, 62.5% of the teachers said that they were either moderately or very interested in an instructionally-related computer course.

Fawson and Smellie (1990) make an additional point:

> Encouragement and incentives should also be provided for professional development activities that allow for updating skills, and keeping abreast of developments in technology-based education. (p. 20-21)

What follows is a list of the goals and objectives which are intended to guide the proposed inservice training program:

Goal 1: Ensure a basic level of teacher computer literacy and facility as it relates to using computers in classrooms.

Objective 1a: After being instructed in the terminology for and function of major components of typical personal computers, teachers will demonstrate their understanding via both a written test and a practicum involving successfully loading software on different computer systems.

Objective 1b: Teachers will be exposed to a wide range of both educational and productivity software and develop a basic facility with each program which will be demonstrated through the completion of one project per program.

Goal 2: Enable teachers to effectively evaluate software for use in their classrooms.

Objective 2a: Having received instruction concerning the resources available to teachers for software evaluation, teachers will be able to generate informed evaluations of a programs.

Objective 2b: When presented with a piece of software, teachers will be able to determine the compatability of the software with a given computer system.

Objective 2c: When presented with a piece of software, teachers will be able to decide on the appropriateness of the software for their own classrooms.

Goal 3: Enable teachers to integrate use of computers into the curriculum for their subject area.

Objective 3a: Having had the techniques of integrating computers into the curriculum modeled for them, teachers will successfully conduct a microteaching session for other teachers in their workshop which integrates computers into a lesson in their subject area.

Objective 3b: Teachers will develop a minimum of 5 lesson

plans for use in their classrooms, which integrate computers into their subject curricula.

Objective 3c: Teachers will write up an evaluation of one of the lessons actually used in their classrooms for presentation at a follow-up workshop.

Goal 4: Enable teachers to maintain an awareness of new computer technologies and innovations.

Objective 4a: Teachers will be exposed to the wide array of trade and professional publications covering state-of-the-art developments in computer systems and software. Based on this information, teachers will subscribe to the publication of their choice for a minimum of one year (no cost for the first year).

Objective 4b: Teachers will tour state-of-the-art production facilities for computer systems and software, developing personal contacts for maintaining awareness of new technologies and innovations.

Objective 4c: At a follow-up workshop, teachers will inform other teachers of at least one new product or technology that they have encountered.

ALTERNATIVE STRATEGIES

Strategies used in the decision matrix, indicated here in bold print, were chosen on the basis of a literature review of research on teacher training in the use of computers and on the basis of conversations with those involved with inservice

teacher training. The strategies will be included as a part of the decision matrix in the next section. The Office of Technology Assessment (1988) suggests some specific vehicles for training, including **schools of education**, regional service centers (such as this state's **regional technical centers**) and **individual school districts** (referred to in this state as Local Education Agencies or LEAs), as well as various combinations of these resources. Private sector **businesses**, such as computer companies and software developers, are also mentioned in terms of sponsoring conferences and seminars for teachers.

The literature review found support for the past effectiveness of regional service centers and individual schools districts for delivering inservice computer training. California has established 15 Teacher Education and Computer (TEC) Centers to provide this type of staff development for teachers (Brandes & Padia, 1985). Both New York State (Office of Technology Assessment, 1988) and the city of Houston (Sturdivant, 1985) have district-level initiatives which emphasize computer applications for the classroom, providing both the training and the support necessary to implement those applications. A comprehensive model also exists for the district-level integration of computer technology into elementary and secondary schools (Zuk & Stilwell, 1984).

There is little in the literature on the track record of either schools of education or private businesses in providing computer training to teachers, though companies such as Apple and IBM have some experience conducting teacher training for

schools or districts where their equipment is installed. Schools of education are included as a strategy because of the faculty and, in most cases, the computing resources available for inservice training.

In a conversation with the associate director of the Center for Math and Science Education at UNC-Chapel Hill, it was noted that there exist organizations which, in partnership with the University of North Carolina system, previously have conducted inservice technology training for teachers. These partnership organizations include the Math and Science Education Network (MSEN) and the Semiconductor Research Corporation (SRC). An attractive aspect of such organizations is their access to federal funds such as National Science Foundation (NSF) and Department of Education (DOE) grants.

Some representative examples of programs already in existence include MSEN's Encouraging Literacy Among Science Teachers (ENLIST), which addresses K-12 teacher leadership and technological literacy issues; and the SRC/MSEN jointly sponsored Vision of Industry and Schools Initiating an Ongoing Network (VISION), intended to educate secondary mathematics and science teachers concerning curriculum content which is applicable to various technology fields.

The ENLIST model provides a realistic approach to the training of a large contingent of teachers. Teams of lead instructors are chosen from each school involved with the program. Before workshops begin, each team is asked to determine goals for their individual schools in order to make the training as appropriate and useful as possible. Following

training, lead instructors return to their schools to conduct training sessions with their colleagues. The concept of training lead instructors would be an important component of any of the strategies listed in this section due to the extensiveness of the proposed program.

CRITERIA FOR CHOICE AND THE DECISION MATRIX

The criteria chosen, indicated in bold print, represent the primary concerns in evaluating each of the above strategies. The criterion of **Availability of Funds** is included with **State Cost** because, given the present situation with the state budget, it will be important to ascertain whether one strategy might have access to funds (federal, private) that another strategy might not. This criterion will receive primary consideration in the choice of a strategy. Total cost for the program is estimated to be approximately $1.3 million. Since individual schools would be required to commit to this training in advance, the estimated cost assumes a 75 percent participation rate for the approximately 300 secondary schools across North Carolina (North Carolina Department of Public Instruction, 1990). The total cost breaks down to a budget of $2,000 for each of two lead teachers per secondary school, which would be used for a stipend and for software, facility and instructor costs; and a budget of $300 for each of the remaining mathematics teachers, which represents software and technical support costs.

Effectiveness is included under **Benefits** because different organizations and institutions will have qualitatively different training programs (more or less comprehensive/appropriate). The remaining criteria of **Past Record**, **Political Feasibility**, **Instructor Availability**, and **Start-up Time** are fundamental implementation concerns which will vary across the different strategy options.

Decision Matrix - Part 1

Strategies \ Criteria	Availability of Funds/ State Cost	Benefits (effectiveness)	Past Record
1. Schools of Education	Dependent on state funds. Approx. $ 1.3M	Limited effect due to older equip. & faculty inexp.w/computers	None
2. Dept. of Public Instruction Regional Technical Centers	Dependent on state funds. Approx. $ 1.3M	Limited effect due to equip. and personnel limitations	California's TEC Centers
3. District (LEA) Initiative with State Support	Shared cost. Approximately $ 750,000	Offers the most appropriate and accessible trng. Effectiveness will vary from LEA to LEA.	N.Y. State and City of Houston district programs; existing model (Zuk & Stillwell, 1984)
4. Partnership Organizations (MSEN, SRC)	Access to federal funds (NSF, DOE). Approximately $ 500,000	Offers greatest potential for thorough and extensive trng.	MSEN ENLIST; SRC/MSEN VISION
5. Private Business Initiative	Shared cost. Approximately $ 750,000	Training on one company's equip./programs potentially less useful	Apple and IBM teacher training for new systems installation
6. Status Quo	None	Potentially negative effect	Inadequate alternative

Decision Matrix - Part 2

Strategies \ Criteria	Political Peasibility	Instructor Availability	Start-up Time
1. Schools of Education	In essence a new state program -- less acceptable.	Available, but would require training	$\geq$ 1 year
2. Dept. of Public Instruction Regional Technical Centers	Established agency, but still dependent on state funds -- acceptable.	Limited staffing. Perhaps dependent on university faculty (see above).	$\leq$ 1 year
3. District (LEA) Initiative with State Support	Less acceptable due to top-down mandate for local funds & personnel	Will vary from district to district. Trng. structure may not exist.	Approximately 1 year
4. Partnership Organizations (MSEN, SRC)	More acceptable because of cost-sharing aspect between state & federal agencies.	Personnel generally available and trained.	$\leq$ 1 year
5. Private Business Initiative	More acceptable because of cost-sharing aspect.	Personnel generally available and trained.	6 months
6. Status Quo	Becoming less acceptable.	Not applicable.	Not applicable

STRATEGY CHOICE AND EVALUATION

As previously mentioned, given the realities of the present budget problems in North Carolina, cost and availability of funds must be a primary consideration in the choice of a strategy. Thus, schools of education and the Department of Public Instruction regional technical centers would be eliminated due to their total reliance on state funds, which would be politically unacceptable. District and private business initiatives are viable options in terms of cost and past record. However, the effectiveness of district initiatives would depend on existing structures for computer training and staff development. Whereas larger schools systems might have a computer coordinator for the secondary schools, as well as staff to support training requirements, there are many districts in North Carolina that would have no such structure in place. The difficulty for private business initiatives is their potentially limited effectiveness in introducing teachers to a broad range of hardware and software, as well as the possible proselytizing nature of the training (e.g., Apple teaches the virtues of Apple).

Based on the criteria used in the decision matrix, the most reasonable choice of strategy for implementing computer inservice training for fulltime public secondary mathematics teachers in North Carolina appears to be a partnership organization such as MSEN or SRC (or both). This strategy limits the need for state funds while ensuring high quality training from an agency specifically created and staffed to promote this kind of program. Additionally, the combination

strategy of a partnership organization working in conjunction with Local Education Agencies (LEAs) would give the program access to federal funds earmarked for district use, further limiting state costs.

Since there are approximately 300 secondary schools in North Carolina, training of lead teachers would have to be conducted by region over two summers. Thus, program evaluation could begin after the first round of workshops and midcourse corrections could be made even before the first contingent of lead teachers returned to their schools. Ultimately, the evaluation of the program would depend on teacher opinion of the usefulness of the training, and the extent to which the training was applied to individual classrooms. The first of these requirements could be met by asking teachers to complete an end-of-workshop evaluation, which would cover such aspects of the training as applicability, appropriateness, and agreement/disagreement concerning the relative emphasis placed on different topics. The second evaluation requirement would be satisfied via teachers meeting the objectives of the program, which include an opportunity for teachers to report during a follow-up workshop on actual lessons they presented involving implementation of computers.

A possible unintended outcome of this type of program would be an impression of elitism on the part of those teachers not involved in the training (non-mathematics teachers) or those not involved in lead teacher training (mathematics teachers not chosen). In order to address these shortcomings, the program eventually could be expanded by

individual schools to include all of their secondary teachers; and there could be established a competition (e.g., essay) among secondary math teachers for the lead teacher positions. An additional unintended consequence might be that gender differences, widely recognized as influencing computer usage (e.g., Kay, 1987), would not be fully addressed in the training. Concern for these differences would have to be reflected in the lead teacher training, including an emphasis of hands-on learning activities that take into account the diversity of experience and comfort levels present among teachers. The need for gender equity could also be met by requiring that at least one of the two lead teachers per school be female, thus increasing the potential meaningfulness of the training for women.

The overall impact of this policy should be positive, since it speaks to a need in this state which has gone largely unmet for over 10 years. An Achilles' heel of the policy is its requirement for a multi-layered approach to training (necessary for carrying out such an extensive program). The partnership organization can conduct an effective training program for lead teachers, but that does not ensure that training will be effective for all secondary mathematics teachers. To increase the likelihood of success, the organization and the state must act as watchdogs for the process, instead of merely assuming the job is being done. Technical and material support must be available to lead teachers whenever they require it, and training materials must be of the highest possible quality. If these guidelines are

adhered to, it is anticipated that this policy will have a positive effect on teaching and learning of mathematics at the secondary level for many years to come.

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